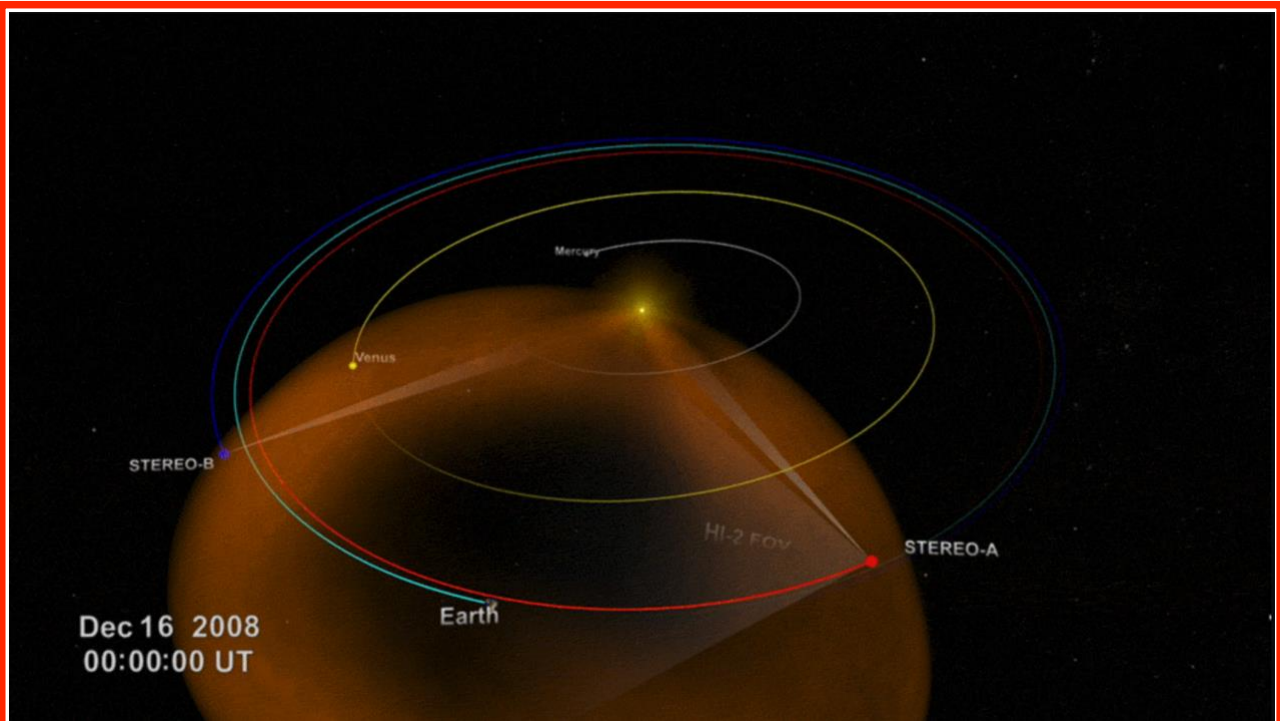


Dear [REDACTED]

\*  
acknowledging  
ferring back  
re-scientist's  
questions in  
previous letter

First I'll respond to your letter. For school, I transferred a lot in college. First I went to UC Riverside and was a psychology major. The next year I transferred to CSU East Bay and became a physics major with a minor in philosophy. Then finally I transferred to UC Santa Cruz and became astrophysics major. I actually got into UC Berkeley for physics too, but my family and friends were all so out of touch with higher education that I had no idea that Berkeley's physics program was the top one in the country (tied with MIT). I don't regret the path I ended up on as a result at all because I love where I am now, but it's an example of what can happen when you don't have people in your life who know a lot about higher education. I spent my last 2.5 years of college at Santa Cruz and was working at Stanford on science research. For graduate school, I went to University of Colorado at Boulder with a major in aerospace engineering sciences. So you can see, I've been a lot of places and tried a lot of different things! I'm interested in documentary filmmaking too; that's really cool that your mom studied that!

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I'm going to talk about this image on the next page. Here's a still image showing the STEREO spacecraft in orbit around the sun, and a big solar eruption. You can see it animated at: <https://www.nasa.gov/sites/default/files/thumbnails/image/stereo-a-b-2008-positions.gif>

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My biggest recommendation about college is to take any and every class that interests you. I largely ignored all of the "general education" requirements but ended up oversatisfying them anyway. College is so amazing because the diversity of classes offered is vast and you can learn from world experts about almost any subject. And you have the time to really dig into it. It's a lot harder to find enough time to commit just to learning after college. So in summary, take advantage of it and enjoy it! As for how many years to go. 4 or 5? I took 4.5 because of all my

transferring and major switching, but I don't regret that extra half year at all. It was more chance to learn more cool stuff.

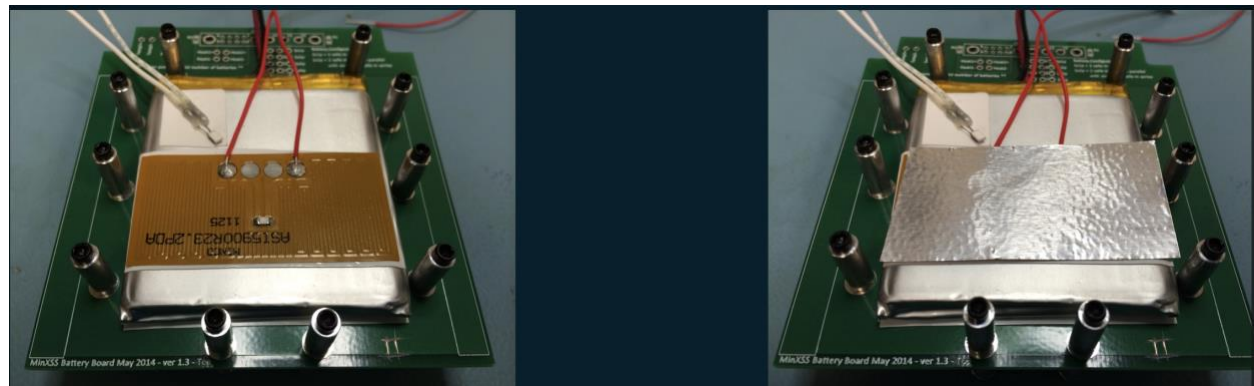
That styrofoam cup/sock experiment in your class sounds really cool! That's a great example of different forces. Most of the ones I work with on the sun are non-contact (magnetic fields, gravity) but there are some inside the sun that require contact ("convection" – the sun is basically boiling up to its surface). Useful stuff to learn about! I also use trigonometry in my work too, mostly because we have this solar mission called STEREO where we sent one ahead of Earth in its orbit around the sun, and one trailing the earth; from those really different viewpoints we can use trig to construct 3D observations of big blobs of plasma popping out of the sun that sometimes get ejected completely (image above).

My winter break was pretty good. I was sad that we didn't go anywhere this year (usually visit grandparents) but we watched lots of Christmas movies, decorated our apartment more than we ever have, and I too played a lot of videogames (though I didn't finish a single one!)

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Now on to the theme for this letter: obstacles I've had to overcome. In my last letter I told you about how I didn't have a great education in math until I got to college, so you know that story. Here's a more recent one: *I made a million-dollar mistake* while I was in graduate school.

This story does have a happy ending. It also has a happy start. I was building the battery pack for the small satellite that I ended up dedicating >5700 hours to (I kept track every week for 6 years). It was awesome. It was real satellite hardware that I was getting to lay hands on even though I was inexperienced student. The really big, expensive satellites tend to only ever be touched by very experienced professionals. I was taking photos of every step of the process as I went. Here are a couple of them. **Can you spot the mistake I made?**



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Those little red wires are going to a heater to keep the batteries warm in space. The ends of the wires are exposed and soldered down to make the electrical connection. Then I put a piece of aluminum foil on top (right picture). Aluminum is electrically conductive. It was all fine for months while we tested the battery pack on the bench and once we put it in the spacecraft and tested it there. Then we put the spacecraft in a vacuum chamber, sucked out all the air (just like it'll be in space), and tried to turn on the spacecraft. It wouldn't stay on. Why? Because that aluminum foil

\*  
Explicit  
explanation  
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letter

got sucked down onto those exposed wires on the resistor when the air was removed. That caused an electrical short in the spacecraft and it wasn't able to boot up like it should. The satellite program cost \$1M.

The happy ending is this: because I had been so meticulous about documenting my work and had taken these photos of each step, we were able to figure out the problem. I'd built multiple battery packs and hadn't made that mistake on the others. So we just swapped out the battery pack in the spacecraft and it worked like a charm after that. Catching problems like this is exactly the reason that we do so much testing in engineering, and *especially* in building satellites because once they are up there, if something isn't working right you can't just grab it and fix it. This was a big moment of learning for me. As soon as we figured out that the problem was my mistake, I felt really really really ashamed. But that only lasted a few minutes or a couple hours. The professionals I was working with didn't blame me or anything – they drilled into me that all the talk about this being the kind of thing that we test for, it's not just talk. That's really what everyone believes. Ultimately, it only cost us a few hours of time to identify the problem and fix it. If we'd launched the satellite without testing it first, it would've been a \$1M loss. Crisis averted

© Here's a photo of it taken by British astronaut Tim Peake who watched it through the window as it got launched from the International Space Station:



You can't see it; but the side facing us is the side that I laser engraved my name, along with everyone else on the team's name, into the outside wall of the satellite.

Here's some questions for you: What's the most difficult thing you've ever accomplished? How do you think you'll decide between majors? What skate trick are you best at?

Sincerely,  
James

\* Asking pre-scientist questions reinforces that you care about learning about them too—strengthens connection. Questions are relevant to theme, support further pursuing higher education, and also relate to pre-scientist's hobby.

\* More photo: related to wo and letter theme. Cool fun fact abo photo to engage pre scientist.